U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Anaea troglodyta floridalis*

COMMON NAME: Florida leafwing butterfly

LEAD REGION: 4

INFORMATION CURRENT AS OF: May 2010

STATUS/ACTION

___ Species assessment - determined we do not have sufficient information on file to support a proposal to list the species and, therefore, it was not elevated to Candidate status
___ New candidate
_X_ Continuing candidate
    _X_ Non-petitioned
    ___ Petitioned - Date petition received:
        __ 90-day positive - FR date:
        __ 12-month warranted but precluded - FR date:
        __ Did the petition request a reclassification of a listed species?

___ Listing priority change
    Former LP: ___
    New LP: ___

Date when the species first became a Candidate (as currently defined): September 12, 2006

___ Candidate removal: Former LPN: ___
    ___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
    ___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
    ___ F – Range is no longer a U.S. territory.
    ___ I – Insufficient information exists on biological vulnerability and threats to support listing.
    ___ M – Taxon mistakenly included in past notice of review.
    ___ N – Taxon does not meet the Act's definition of "species."
    ___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Insects, Nymphalidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Florida, U.S.

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Florida, Miami-Dade and Monroe Counties, U.S.

LAND OWNERSHIP: The mainland population is within Long Pine Key in Everglades National Park (ENP). Total acreage including land and water of ENP in Miami-Dade, Monroe, and Collier Counties is 610,684 hectares [ha] (1,509,000 acres). In addition, sporadic and localized occurrences have been found within pine rockland fragments on lands owned by Miami-Dade County. In the Keys, the butterfly had previously occurred on Big Pine Key within the National Key Deer Refuge (NKDR) and on private, State, and other lands (Salvato and Hennessey 2003, p. 243); NKDR is 3,723 ha (9,200 acres). However, the Florida leafwing has not been seen on Big Pine Key since 2006 and may now be extirpated from the Keys (M. Salvato, Service, pers. comm. 2007, 2010; M. Minno, Eco-Cognizant, Inc., pers. comm. 2009a).

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BIOLOGICAL INFORMATION

Species Description: The Florida leafwing butterfly is a medium-sized butterfly approximately 2.75 to 3 inches (in) (76 to 78 millimeters [mm]) in length with a forewing length of 1.3 to 1.5 in (34 to 38 mm) and has an appearance characteristic of its genus (Comstock 1961, p. 44; Pyle 1981, p. 651; Opler and Krizek 1984, p. 172; Minno and Emmel 1993, p. 153). The upper-wing (or open wing) surface color is red to red-brown, the underside (closed wings) is gray to tan, with a tapered outline, cryptically looking like a dead leaf when the butterfly is at rest. The Florida leafwing exhibits sexual dimorphism, with females being slightly larger and with darker coloring along the wing margins than the males. The species also has seasonal forms (Salvato and Hennessey 2003, p. 244). Comstock (1961, p. 44-45) employed the terms "summer" and "winter" morph to differentiate between seasonal forms within the genus. The length of photoperiod exposure experienced by fifth-instar larvae (several days prior to pupation), as well as the influence of seasonal moisture have been identified as key factors in determining the seasonal forms within members of the *Anaea* genus of leafwing butterflies (Riley 1980, p. 333; 1988a, p. 266; 1988b, p. 226; Salvato and Hennessey 2003, p. 246). The summer form (wet-season or long-day form), occurring in late May to September, tends to have forewing margins that are blunt and a hind-wing with a less pronounced tail; colors also tend to be brighter. The winter form (dry-season or short-day form), occurring in October to early May, tends to have the opposing characters, with pronounced tails and crescent-shaped forewings (Comstock 1961, p. 44-45; Salvato 1999, p. 118; Salvato and Hennessey 2003, p. 246).

Eggs are spherical and light cream-yellow in color (Worth et al. 1996, p. 64). The first three instars begin what continues throughout the larval development to be a remarkable co-evolved cryptic mimicry of the hostplant, pineland croton (*Croton linearis*) (Euphorbiaceae). These stages appear like dead leaves, with a brown color and resting on a dead part of the plant during the day (Salvato 1999, p. 118; 2003, p. 244). These instars tend to eat the leaves to the mid-vein

and then dangle from them in camouflage. In addition, the first two instars make a frass chain for protection from predators (Salvato and Salvato 2008, p. 327). Briefly, a frass chain is created when *Anaea* larvae attach their fecal pellets to the mid-vein of a partially eaten croton leaf with silk (Minno et al. 2005, p. 115). The larvae then crawl to the terminus of this strand to avoid predation. The two later instars are light green in color, with a tapering body from the cephalad (head capsule) to the caudal end, so that when at rest, it also appears like a croton leaf in the spiral fashion of the terminal end (Worth et al. 1996, p. 64). The head capsule during all stages bears many tiny setae, presenting the granular appearance of croton seeds (Worth et al. 1996, p. 64).

Taxonomy: The Florida leafwing butterfly (*Anaea troglodyta floridalis*) was first described by Johnson and Comstock in 1941. *Anaea troglodyta floridalis* is a taxon considered to be both endemic to south Florida and clearly derived from Antillean stock (Comstock 1961, p. 45; Brown and Heineman 1972, p. 124; Minno and Emmel 1993, p. 153; Smith et al. 1994, p. 67; Salvato 1999, p. 117; Hernandez 2004, p. 39; Pelham 2008, p. 393). Some authors (Comstock 1961, p. 44; Miller and Brown 1981, p. 164; Smith et al. 1994, p. 67; Hernandez 2004, p. 39) place the Florida leafwing as a distinct species, *A. floridalis*. Others (Brown and Heineman 1972, p. 124; Minno and Emmel 1993, p. 153; Salvato 1999, p. 117; Opler and Warren 2002, p. 40) consider the Florida leafwing as a subspecies of *Anaea troglodyta* Fabricius. Smith et al. (1994, p. 67) suggest that further comparison between immature stages of the Florida leafwing and its Antillean relatives may aid in determining whether or not the Florida leafwing is distinct at the species or subspecies level. Opler and Warren (2002, p. 40) and Pelham (2008, p. 393) consider *Anaea troglodyta floridalis*, not *A. floridalis*, as the scientific name for the Florida leafwing.

The Integrated Taxonomic Information System (2010, p. 1) uses the name *Anaea troglodyta floridalis* (F. Johnson and W. Comstock, 1941) and indicates that this species' taxonomic standing is valid. The Florida Natural Areas Inventory (FNAI) (2010, p. 19) and NatureServe (2009, p. 1) use the name *A. t. floridalis*.

We have carefully reviewed the available taxonomic information regarding the Florida leafwing. While there is some disagreement as to whether this butterfly is distinct at the species level (Comstock 1961, p. 44; Miller and Brown 1981, p. 164; Smith et al. 1994, p. 67; Hernandez 2004, p. 39) or at the subspecies level (Brown and Heineman 1972, p. 124; Minno and Emmel 1993, p. 153; Salvato 1999, p. 117; Opler and Warren 2002, p. 40, Pelham 2008, p. 393), there is no question that the Florida leafwing is a valid taxon and entity that could be listed pursuant to the Endangered Species Act.

Habitat/Life History: The Florida leafwing occurs only within pine rocklands that retain its hostplant, pineland croton. Pineland croton, a subtropical species of Antillean origin, is the only known hostplant for the leafwing (Opler and Krizek 1984, p. 172; Schwartz 1987, p. 22; Minno and Emmel 1993, p. 153; Smith et al. 1994, p. 67). Once occurring throughout the pine rocklands of the lower Florida Keys (Dickson 1955, p. 98; Hennessey and Habeck 1991, p. 13; Salvato 1999, p. 3), pineland croton now occurs only on Big Pine Key. The last reports of the hostplant from other keys were from No Name in 1992 (Carlson et al. 1993, p. 923) and from

Little Pine in 1988 (Hennessey and Habeck 1991, p. 4). Recent surveys of relict pineland throughout the lower Keys by Salvato (1999, pers. comm. 2008) failed to locate the plant from any island other than Big Pine. Hennessey and Habeck (1991, p. 4) and Salvato (1999, p. 3) estimated that approximately 80 ha (198 acres) of croton-bearing pine rockland habitat occur on Big Pine Key. More recently, Chad Anderson (pers. comm. 2010), biologist at NKDR, estimated roughly 243 ha (600 acres) of croton on Big Pine Key, based upon Bradley's pine rockland data and personal observations.

Another 1,068 ha (2,639 acres) of pine rockland habitat with pineland croton occur within ENP (Hennessey and Habeck 1991, p. 4; Salvato 1999, p. 3). ENP staff and volunteers are mapping croton throughout Long Pine Key, but more information on its distribution is needed (J. Sadle, pers. comm. 2007, 2010a; S. Perry, pers. comm. 2007). Minno (pers. comm. 2009a) characterizes habitat for the leafwing as forest. Edges of hardwood hammocks within pine rocklands near patches of croton are important because males use these areas to await females (M. Minno, pers. comm. 2009a).

Numerous authors have observed and documented the behavior and natural history of the Florida leafwing (Lenczewski 1980, p. 17; Pyle 1981, p. 651; Baggett 1982, p. 78-79; Opler and Krizek 1984, p. 172; Schwartz 1987, p. 22; Hennessey and Habeck 1991, p. 13-17; Smith et al. 1994, p. 67; Worth et al. 1996, p. 4-6; Salvato 1999, p. 116-122; Salvato and Hennessey 2003, p. 243-249). Adults are rapid, wary fliers. The species is extremely territorial, with both sexes flying out to pursue other butterflies (Baggett 1982, p. 78; Worth et al. 1996, p. 65; Salvato and Hennessey 2003, p. 246). Minno (pers. comm. 2009a) notes that males are generally more territorial. The Florida leafwing is multivoltine (i.e., produces multiple generations per year), with an entire life cycle of about 60 days (Hennessey and Habeck 1991, p. 17) and maintains continuous broods throughout the year (Salvato 1999, p. 121). The precise number of broods per year remains unknown, but the leafwing has been recorded in every month (Baggett 1982, p. 78; Opler and Krizek 1984, p. 172; Minno and Emmel 1993, p. 153; Salvato and Hennessey 2003, p. 247). Females lay eggs singly on both the upper and lower surface of the host leaves, normally on developing racemes (Baggett 1982, p. 78; Hennessey and Habeck 1991, p. 16; Worth et al. 1996, p. 64; Salvato 1999, p. 120). Worth et al. (1996, p. 64) and Salvato (1999, p. 120) visually estimated that females may fly more than 30 meters (98 feet) in search of a suitable host and usually require less than a minute to oviposit each egg.

Adults have been observed feeding on rotting fruit and dung (Baggett 1982, p. 78; Opler and Krizek 1984, p. 172; Minno and Emmel 1993, p. 153), senescent flowers of saw palmetto (*Serenoa repens*) (Hennessey and Habeck 1991, p. 13), a sliced orange (Salvato 1999, p. 121), and sap of willow bustic (*Sideroxylon salicifolium*) excreted from feeding holes created by yellow-bellied sapsuckers (*Sphyrapicus varius*) (Salvato and Salvato 2008, p. 326). Adults are not frequently attracted to flowers (Baggett 1982, p. 78; Opler and Krizek 1984, p. 172; Worth et al. 1996, p. 65). However, in November 2008 and October 2009, Salvato and Salvato (in press) observed freshly emerged adults taking nectar from a variety of plants, including, Spanish needles (*Bidens alba*), shrubverbena (*Lantana camara*), and false mallow (*Malvastrum corchorifolium*) within a weedy disturbed area on the extreme southern border of Long Pine Key. Adults reared and kept in captivity have not been reported to feed at flowers, but do feed on

various artificial sources (e.g., beer) (Salvato 1999, p. 122; Salvato and Hennessey 2003, p. 248).

Lenczewski (1980, p. 17) observed adults at the edges of mud puddles. Salvato and Hennessey (2003, p. 248) also observed this puddling behavior by adult male leafwings on Big Pine Key and in the Everglades.

Historical Range/Distribution: *Anaea troglodyta floridalis* is endemic to south Florida and the lower Keys. The species was locally common within pine rockland habitat that once occurred within Miami-Dade and Monroe Counties and was less common and sporadic within croton-bearing pinelands in Collier, Martin, Palm Beach, and Broward Counties (Baggett 1982, p. 78; Smith et al. 1994, p. 67; Salvato 1999, p. 117; Salvato and Hennessey 2003, p. 243).

There is little recent evidence that the Florida leafwing ventured further north than southern Miami-Dade to make use of localized, relict populations of hostplants that still persist as far north as Martin County (Salvato 1999, p. 117; Salvato and Hennessey 2003, p. 243). Furthermore, although the leafwing was widely reported from several locations in southern Miami until the mid-20th century, Salvato (1999, p. 117) has found few documented field sighting records or museum collection specimens from areas north of Monroe and Miami-Dade Counties, suggesting that it may not have been common further north historically (Salvato and Hennessey 2003, p. 243).

Current Range/Distribution: Populations of Florida leafwing have become increasingly localized as pine rockland habitat has been lost or altered through anthropogenic activity (Baggett 1982, p. 78; Hennessey and Habeck 1991, p. 4; Schwarz et al. 1996, p. 59; Salvato and Hennessey 2003, p. 243). Long Pine Key contains the largest remaining coverage of pine rockland habitat (8,029 ha) (19,840 acres) on the mainland (Salvato 1999, p. 3; Service 1999, p. 173; Salvato and Hennessey 2004, p. 223). Hennessey and Habeck (1991, p. 4) and Salvato (1999, p. 3) estimated that approximately 1,068 ha (2,638 acres) of appropriate hostplant-bearing pine rockland habitat occur within Long Pine Key. This figure may underestimate the amount of actual croton-bearing pine rockland within ENP, but it is the best estimate at this time. More information on the distribution of croton within Long Pine Key is needed (J. Sadle, pers. comm. 2007; S. Perry, pers. comm. 2007).

In Miami-Dade County, outside of ENP, there are approximately 375 pine rockland fragments remaining totaling approximately 1,780 ha (4,398 acres) (Service 1999, p. 173). Although several of these fragments, particularly those adjacent to ENP, such as Navy Wells Pineland Preserve and Camp Owaissa Bauer Hammock, appear to maintain small, localized populations of croton, Salvato and Hennessey (2004, p. 223) and Salvato (pers. comm. 2008) have generally failed to observe the leafwing in these or other mainland areas outside ENP. During June 2007, one leafwing was observed within Navy Wells (M. Salvato, pers. comm. 2008), but none have been recorded outside of ENP since that time. A GIS analysis conducted by the Service using data collected by The Institute for Regional Conservation (IRC) in 2004 indicates that 65 pine rockland fragments containing pineland croton remain in private ownership in Miami-Dade County totaling approximately 190 ha (470 acres) (IRC 2006, p. N/A). Another 12 fragments totaling 180 ha (446 acres) contain croton and are in public ownership (IRC 2006, p. N/A).

In the lower Keys, Big Pine Key retains the largest undisturbed tracts of pine rockland habitat totaling an estimated 701 ha (1,732 acres) (Folk 1991, p. 218; Hennessey and Habeck 1991, p. 4; Salvato and Hennessey 2004, p. 223). The 2004 land cover data from South Florida Water Management District shows 516 ha (1,276 acres) of pine rockland on Big Pine Key (M. Minno, pers. comm. 2009a). Although relict pine rocklands can still be found on several other islands within NKDR, only Big Pine Key maintains pineland croton (Salvato 1999, p. 4; Salvato and Hennessey 2003, p. 243; 2004, p. 223). Hennessey and Habeck (1991, p. 4) and Salvato (1999, p. 3-9) estimated that approximately 80 ha (198 acres) of croton-bearing pine rockland occur on Big Pine Key. More recently, Anderson (pers. comm. 2010) suggested an estimate of 243 ha (600 acres) of croton on Big Pine Key. However, the butterfly has not been seen in the Keys since 2006 (M. Salvato, pers. comm. 2007, M. Minno, pers. comm. 2009a).

The reduction in range and limited distribution for this butterfly is of serious concern. Minno (pers. comm. 2009a) believes the Florida leafwing is now extant and breeding only in ENP and nowhere else. Similarly, staff at ENP are concerned because it may now have the only population remaining (S. Perry, pers. comm. 2008; J. Sadle, pers. comm. 2010b).

Population Estimates/Status: Based on results of all historic (Baggett 1982, p. 78; Schwartz 1987, p. 22; Hennessey and Habeck 1991, p. 17; Worth et al. 1996, p. 62; Schwarz et al. 1996, p. 59) and recent surveys and natural history studies (Salvato 1999, p. 1; 2001, p. 8; 2003, p. 53; Salvato and Hennessey 2003, p. 243), the Florida leafwing is extant in ENP and, until recently, had occurred on Big Pine Key and rarely in pineland fragments in mainland Miami-Dade County (M. Salvato, pers. comm. 2007, 2008). Schwartz (1987, p. 1-19), Hennessey and Habeck (1991, p. 1-75), Emmel et al. (1995, p. 7) and Salvato (1999, p. 1-168), searched the lower Florida Keys extensively for the Florida leafwing, only encountering the species on Big Pine Key. In the Everglades, Hennessey and Habeck (1991, p. 1-75) and Salvato (1999, p. 1-168; 2001, p. 8-14) reported the species from Long Pine Key. Hennessey and Habeck (1991, p. 40, 42) reported an estimate of 3.7 adults per ha (1.5 per acre) during 1988-1989 from survey transects at both Watson's Hammock at NKDR on Big Pine Key and on Long Pine Key in ENP. During 1997-1998, Salvato (1999, p. 52) estimated 3.1 and 2.4 adults per ha (1.2 and 1.0 per acre) at Watson's Hammock at NKDR and the Gate 4 region of Long Pine Key in ENP, respectively; these were at higher densities than what was found on survey transects elsewhere in his study.

During 1999-2002, Salvato (pers. comm. 2009) recorded an average of 10.9 adults per ha (4.4 per acre) in the Watson's Hammock area, while other locations on Big Pine Key have yielded an average of 0.3 to 6.5 adults per ha (0.1 to 2.6 per acre). The higher densities in Watson's Hammock have been attributed to the fact that this is the only pine rockland area on Big Pine Key restricted from chemical pesticide applications for mosquito control (Hennessey and Habeck 1991, p. 1; Hennessey et al. 1992, p. 715; Salvato 2001, p. 8). However, analysis of survey data collected from 2003 through 2007 indicate a substantial decline in leafwing numbers on Big Pine, even within Watson's Hammock (M. Salvato, pers. comm. 2009). During 2003-2006, Salvato (pers. comm. 2009) recorded an average of 1.5 adults per ha (0.6 per acre) in Watson's Hammock; other locations on Big Pine Key yielded an average of 0 to 1.3 per ha (0 to 0.5 per acre). Salvato (pers. comm. 2010) recorded three larvae and one adult in 2006. No leafwings

were recorded on Big Pine Key after 2006 (M. Salvato, pers. comm. 2009).

Salvato and Salvato (in press) have found leafwings within Long Pine Key to be highly variable ranging from 4 to 60 individuals observed annually at Gate 4 based on monthly studies from 1999-2010. In addition, Salvato and Salvato (in press) have monitored populations of the leafwing elsewhere within Long Pine Key as well as within adjacent habitats (Palma Vista Hammock and several former agricultural and military lands) during 2005-2010 and encountered similar, variable densities throughout the survey period. Similarly, Perry (pers. comm. 2007) has observed only small, scattered occurrences within the spatially extensive pineland area of Long Pine Key. She notes that counts are typically only in the single digits during her survey efforts.

Salvato (pers. comm. 2009) has generally found about one leafwing per ha (0.4 per acre) during recent surveys of ENP during select seasons and none on Big Pine Key. Salvato (pers. comm. 2010) indicates that the current population size ranges from several hundred or fewer, although it varies greatly depending upon season and other factors. However, Minno (pers. comm. 2009a) estimated the population size at less than 100 per day on 8 to 12 ha (20 to 30 acres) within ENP. In ENP, the species is most often encountered from late fall through spring, and less abundant during the summer (Salvato and Salvato, in press). However, the species appeared to maintain a consistent phenology when it occurred on Big Pine Key (Salvato and Salvato, in press).

Minno (pers. comm. 2007, 2008) believes that the Florida leafwing is either extremely rare or extirpated from the Keys and the Navy Wells site based on surveys since August 2006. Minno indicates that this species was common on Big Pine Key in the 1980s, but the habitat, due to lack of fire, has changed dramatically in recent years. Minno (pers. comm. 2009a) believes the butterfly is now less common than the endangered Schaus swallowtail (*Heraclides aristodemus ponceanus*). In short, Minno (pers. comm. 2007, 2008) believes that this species has declined greatly since the 1980s and is not likely to survive without special efforts.

In short, the Florida leafwing butterfly is considered to have a low population size, roughly several hundred or fewer (M. Salvato, pers. comm. 2010). Its overall status is tenuous. On the mainland, it is found in ENP. Outside of ENP, it is only sporadically found in locations such as Navy Wells and other fragments in Miami-Dade County near ENP. It may be extirpated from Big Pine Key, since it has not been found at that location since 2006 (M. Salvato pers. comm. 2010).

The leafwing has a rounded global status of T1, critically imperiled because of extreme rarity (i.e., 5 or fewer occurrences of less than 1,000 individuals) or because of extreme vulnerability to extinction due to natural or manmade factors (NatureServe 2009, p. 1). The basis for this ranking stems from its very limited remaining range, overall threats (e.g., destruction of habitat on Big Pine Key, pesticide application, fire, lack of fire, stochastic events), and decline, which make it highly vulnerable to extinction (NatureServe 2009, p. 1-2). FNAI (2010, p.19) places the leafwing at "G4?T1", species tentatively demonstrably secure globally, subspecies critically imperiled. The leafwing is also considered threatened by the Florida Committee on Rare and Endangered Plants and Animals (Deyrup and Franz 1994, p. 249). However, these designations provide no legal authority or protection. The leafwing is recognized in Florida's Comprehensive

Wildlife Conservation Strategy as one of Florida's species of greatest conservation need, with status low and trend declining (FWC 2005, p. 91). The Florida leafwing is not listed as endangered or threatened in Florida and there is no wildlife management plan for this species.

THREATS

A. The present or threatened destruction, modification, or curtailment of its habitat or range. The pine rockland community of southern Florida is critically imperiled globally (FNAI 2010, p. 26). . Destruction of the pinelands for economic development has reduced this community by 90 percent on mainland south Florida (O'Brien 1998, p. 208). Similarly, most of the ecosystems on the Keys have been impacted by humans, through widespread clearing of habitat in the 19th century for farming, or building of homes and businesses; extensive areas of pine rocklands have been lost (Hodges and Bradley 2006, p. 6). In short, development has removed and, or fragmented pine rocklands from the majority of the leafwing's former range (Service 1999, p. 170; Salvato 1999, p. 3). This rapid loss of habitat and the resulting increased distance between substantial populations of croton in remaining pine rocklands is the most likely cause for the disappearance of the leafwing from its historic range (Salvato and Hennessey 2003, p. 243; Salvato and Salvato 2008, p. 323; Salvato and Salvato, in press).

The threat of habitat loss of remaining, unprotected pine rocklands continues. Pine rockland fragments outside of ENP contain pineland croton and can provide habitat for the Florida leafwing. Salvato and Hennessey (2003, p. 243) and Salvato (pers. comm. 2008) have generally failed to observe the leafwing in these or other mainland areas outside ENP. However, during June 2007, a single stray leafwing was observed within Navy Wells, suggesting the species may still occur in these fragments (M. Salvato, pers. comm. 2008). A GIS analysis for Miami-Dade County indicates that 65 pine rockland fragments containing croton remain in private ownership, totaling approximately 190 ha (470 acres) (IRC 2006, p. N/A). In short, any populations of Florida leafwing occurring on unprotected lands remain threatened by habitat destruction or modification.

Similarly, while NKDR retains the largest undisturbed tracts of pine rockland habitat in the lower keys, other areas on Big Pine Key containing occupied and suitable habitat for the Florida leafwing remain unprotected. Therefore, suitable habitat outside of NKDR remains at risk. Residential and commercial development has degraded essential components of Florida leafwing habitat and continues to pose a threat to remaining habitat. Additional habitat loss on Big Pine Key threatens Florida leafwing populations, if extant, and further reduces the feasibility of the species re-establishment on the island.

The threat of habitat destruction or modification is further exacerbated by lack of prescribed fire and suppression of natural fires. Natural fires are an important part of maintaining an ecosystem's gradual succession and are important in maintaining the herbaceous layer of pine rocklands of which pineland croton is a part (Loope and Dunevitz 1981, p. 5; Carlson et al. 1993, p. 914; Olson and Platt 1995, p. 101; Bergh and Wisby 1996, p. 1). In pine rockland habitat, fires occurred from lightning and as a consequence of use by native Americans. Re-sprouting after burns is the primary mechanism allowing for the persistence of perennial shrubs in pine habitat (Olson and Platt 1995, p. 101). Without fire, successional

climax from tropical pineland to hardwood hammock is rapid, and displacement of native species by invasive exotic plants often occurs. However, due to the proximity of remaining pine rockland habitat to urban areas much of these natural fires (outside of ENP) have been suppressed, often replaced by inconsistent regimes of managed or prescribed fires. The conversion of pine rockland into hardwood hammock is continuing on northeastern Big Pine, No Name, Cudjoe, Sugarloaf, and Little Pine Keys. Pineland croton is now absent from these locations.

Prescribed fire is used throughout the pine rocklands of Long Pine Key and has been consistently used for the past 50 years (Loope and Dunevitz 1981, p. 5; Salvato 1999, p. 8). Little is known about the fire history in ENP prior to 1947, and at first, fires were suppressed (Slocum et al. 2003, p. 93). Fires were reintroduced in the late 1950s, but were not well understood (Slocum et al. 2003, p. 93). However, many of the prescribed burns conducted in Long Pine Key during this time period were quite extensive, with several areas (now known as burn blocks) treated simultaneously. Beginning in 1989, efforts were made to generate more natural fire regimes by focusing on increasing frequency and shifting the timing of burn from the nonlightning (winter) to lightning (summer) seasons (Slocum et al. 2003, p. 93). In 1989 and 1990, all of Long Pine Key was prescribed burned during the early to middle lightning season to initiate a restoration effort based on the hypothesized natural fire regime (i.e., increased frequencies and correct timing) (Slocum et al. 2003, p. 93). Since that time, fires have been ignited every 2 to 3 years, with most ignitions occurring in the early to middle lightning season (Slocum et al. 2003, p. 93). Although this has resulted in restoration of species-rich, herbaceous-dominated pine rocklands in many areas, including resurgence of croton, populations of croton appear fragmented. The leafwing, with its strong flight abilities, can disperse to make use of adjacent patches of hostplant and then quickly recolonize burned areas following hostplant resurgence (Salvato 1999, p. 5; 2003, p. 53). The desired fire return interval for prescribed fires in Long Pine Key is considered to be 2 to 5 years (A. Land, pers. comm. 2010). However, any immature stages of Florida leafwing will be destroyed by fire (M. Minno, pers. comm. 2009a). In addition, there is an apparent delay in the return of hostplants and eventual recolonization (Salvato and Salvato, in press; A. Land, pers. comm. 2009a) (see Threats, Factor E below).

Salvato and Salvato (in press) encountered similar adult Florida leafwing densities pre- and post-burn throughout their ten-year study within Long Pine Key, suggesting the species may be able to quickly re-colonize pine rocklands following a fire. Surveys conducted shortly after burns often found adult leafwings actively exploring the recently burned locations in search of new hostplant growth (Salvato and Salvato, in press). In most instances croton returned to the burned parts of Long Pine Key at one to three months post-burn, however it may take up to six months before the leafwing will use the new growth for oviposition (Salvato and Salvato, in press; A. Land, pers. comm. 2010).

Prescribed fire of select portions of pine rockland habitat at Long Pine Key aids the leafwing in two ways. First, partial and systematic prescribed burns allow adult butterflies a corridor (refugia) to flee within during the fires. Second, it allows for faster re-colonization by maintaining adult butterflies in areas adjacent to burn sites. In the past, populations of

leafwings were likely lost, if refugia were not available when large prescribed burns (involving multiple burn blocks) were conducted.

The NPS acknowledges that listed species and their habitats are the principle natural values at risk within pine rocklands (i.e., Fire Management Unit 3) (NPS 2005, p. 22-30). ENP is working on incorporating considerations for life histories of select butterfly species into its management, but there may be some inconsistencies between implementation of the plan and meeting the needs for select species. At one point, low numbers of butterflies in the pinelands were partially attributed to burning too soon following hurricanes and flooding and before host plants were fully recovered, as well as other factors (S. Perry, NPS, pers. comm. 2007). In May 2005, select portions of Long Pine Key were prescribed burned, and resurgence of vegetation within these burned areas was then set back due to storm damages caused by Hurricanes Katrina and Wilma later that year (Salvato and Salvato, in press). By mid-2006, these had not recovered, yet burns adjacent to these areas continued, removing available hostplants (Salvato and Salvato, in press) throughout burn blocks F2 and F1 in Long Pine Key. However, ENP staff did not detect any strong changes in croton height or crown area following Hurricanes Katrina or Wilma within study plots used as part of its croton monitoring study (A. Land, pers. comm. 2008). The extent of croton damage and recovery following storms might be affected by fire. Salvato and Salvato (in press) indicated that croton occurring in the unburned block G, which is immediately north of burn blocks F2 and F1, was not damaged during 2005 storm activity.

Although management in ENP in recent years has benefited the leafwing, adaptive management needs to be implemented during instances where recovery of recently burned areas is slowed. Buffer zones were established to serve as a refuge area for the Florida leafwing as part of prescribed burns conducted in Long Pine Key during July 2007 (M. Salvato, pers. comm. 2008, S. Perry, pers. comm. 2007). It is unclear if the buffer zones had a positive or negative effect on the butterfly population (J. Sadle, pers. comm. 2010a). Effects may be unclear because the buffer zones were partially burned during prescribed fire activities that year. Refugia should be included as part of burns planned within occupied leafwing habitat, wherever possible. In years where abundance is especially low, specific areas of occupied habitat may need to be avoided to help safeguard the species over the long-term (S. Perry, pers. comm. 2007; Minno and Minno, 2008, p. 1).

The Florida leafwing has been documented to occur sporadically within Navy Wells Pineland Preserve in Miami-Dade County (M. Salvato, pers. comm. 2008). In August and November 2007, approximately 14 ha (35 acres) of pine rockland habitat was prescribed burned at Navy Wells Pineland Preserve. Additional pine rocklands occur at Navy Wells and may continue to support the leafwing population on the site; these areas should not be burned until hostplants have recovered (M. Salvato, pers. comm. 2008). Salvato (pers. comm. 2010) believes that a fire-return interval of 3 to 5 years may be most conducive for maintaining Florida leafwing habitat on the mainland; less frequent fire is needed in the Keys. Miami-Dade County appears willing to implement needed measures to protect the Florida leafwing (J. Maguire, Miami-Dade County, pers. comm. 2008a). In addition, the County is working with Fairchild Tropical Botanic Garden (FTBG) to implement a fire monitoring program at

its preserves (Possley and Maschinski 2007, 1-13; J. Maguire, pers. comm. 2008b). As part of this program, croton will be mapped and fire effects will be studied (J. Maguire, pers. comm. 2008a; Possley and Maschinski 2007, p. 3).

The objectives of the current NKDR fire management program are to: (1) protect human life, property, and other resources from unwanted fire; and (2) restore and maintain biological diversity using fire as a viable ecological process (Service 2000, p. 1). The latter includes maintaining biological diversity in fire-maintained plant communities by prescribed fire and also controlled natural fire under Service guidelines and maintaining habitat for trust resources, including listed plant and animal species, especially the Key deer, through prescribed fire and controlled natural fire (Service 2000, p. 1). The fire management plan for NKDR mentions Florida leafwing and its reliance on its fire-dependent hostplant and indicates that "Concern has been raised that fire suppression is contributing to the decline of these species as the host plant requires a fire-maintained open pineland to persist (Emmel et al. 1995)." (Service 2000, p. 19). However, no specific details are provided to enhance habitat or to avoid or mitigate impacts to Florida leafwing. In addition, management of pine rocklands by NKDR is made particularly difficult by the pattern of land ownership and development; private homes and light commercial uses are embedded within or in close proximity to the fire-sustained pineland habitat (Service 2000, p. 10).

Salvato (1999, p. 151; 2003, p. 57) suggested that burns are not being administered as thoroughly in Watson's Hammock within NKDR as is needed to prevent loss of pine rocklands. As a result much of the pine rocklands within northern Watson's Hammock are being compromised by hardwood hammock (Salvato and Hennessey 2004, p. 225). In addition, fire breaks leading into Watson's Hammock have been expanded; these expansions included cutting back and removing large quantities of native vegetation, including croton (M. Salvato, pers. comm. 2008). During 2009, a fire break on NKDR, running the length of Key Deer Boulevard on Big Pine Key, was mowed by volunteers, thereby cutting back numerous crotons (M. Salvato, pers. comm. 2010). For over a decade the crotons growing within these fire breaks have been actively used by the species (Salvato and Salvato, in press).

The NKDR is attempting to increase the density of hostplants within the pine rockland forests through the use of prescribed fire. These efforts may benefit Florida leafwing populations on Big Pine Key, if extant, and aid the species in re-establishment within NKDR. However, there is a backlog of pine rocklands that need to be burned. Of 318 pine rockland plots that were initially assessed on Big Pine Key in 2005, 110 were not burned, 77 were burned once, 55 were burned twice, and 76 were burned either three or four times since 1960 (Bradley and Saha 2009, p. 22). Complete implementation of a prescribed fire program in the lower Keys has been hampered by an incomplete understanding of the fire ecology in the area, a shortage of resources, and by public opposition to burning. Complicating the issue is that many homes on Big Pine Key have been built in a mosaic of pine rockland, so the use of prescribed fire in many places has become complicated because of potential danger to structures. The Service is working cooperatively with Florida International University in Miami to determine the proper fire frequencies necessary to maintain the pine rockland

community on NKDR (Snyder et al. 2005, p. iv - v). Only two burns totaling 4 ha (10 acres) were burned on NKDR in 2009 (A. Morkill, pers. comm. 2010). Until more prescribed fires are conducted, fire breaks may provide good habitat on the island because these areas are open, yet mowed or cleared very rarely (C. Anderson, pers. comm. 2010). For example, Anderson (pers. comm. 2010) found croton to be at a density of 0.04 plants per m^2 in the forested plots and 0.27 m^2 plants per plot on the fire breaks. Overall, lack of appropriate fire management continues to be a threat for this species at NKDR and surrounding lands on Big Pine Key. Future actions should avoid mowing of fire breaks with high densities of hostplants and implementing more fire in overgrown areas on NKDR, to the extent possible. Climatic changes and sea level rise are major threats to south Florida, including this species and its habitat. The Intergovernmental Panel on Climate Change (IPCC) reported that the warming of the world's climate system is unequivocal based on documented increases in global average air and ocean temperatures, unprecedented melting of snow and ice, and rising average sea level (IPCC 2007, p. 2; 2008, p. 15). Sea-level rise is the largest climate-driven challenge to low-lying coastal areas and refuges in the sub-tropical ecoregion of southern Florida (U.S. Climate Change Science Program [CCSP] 2008, p. 5-31, 5-32). The long-term record at Key West shows that sea level rose on average 0.088 inches (0.224 cm) annually between 1913 and 2006 (National Oceanographic and Atmospheric Administration [NOAA] 2008, p. 1). This equates to approximately 8.76 inches (22.3 cm) over the last 100 years (NOAA 2008, p. 1).

IPCC (2008, p. 28) emphasized it is very likely that the average rate of sea-level rise during the 21st century will exceed that from 1961 to 2003 (i.e., 0.071 inches [0.18 cm] per year), although it was projected to have substantial geographical variability. Partial loss of the Greenland and, or Antarctic ice sheets could result in many feet (several meters) of sea-level rise, major changes in coastlines, and inundation of low-lying areas (IPCC 2008, p. 28-29). Low lying islands and river deltas will incur the largest impacts (IPCC 2008, p. 28-29). According to CCSP (2008, p. 5-31), much of low-lying, coastal south Florida "will be underwater or inundated with salt water in the coming century."

IPCC (2008, p. 3, 103) concluded that "climate change is likely to increase the occurrence of saltwater intrusion into coastal aquifers as sea level rises" and that "sea-level rise is projected to extend areas of salinisation of groundwater and estuaries, resulting in a decrease of freshwater availability for humans and ecosystems in coastal areas." Since the 1930s to 1950s, increased salinity of coastal waters contributed to the decline of cabbage palm forests in southwest Florida (Williams et al. 1999, p. 2056-2059), expansion of mangroves into adjacent marshes in the Everglades (Ross et al. 2000, p. 9, 12-13), and loss of pine rockland in the Keys (Ross et al. 1994, p. 144, 151-155). Hydrology has a strong influence on plant distribution in these and other coastal areas (IPCC 2008, p. 57). Such communities typically grade from salt to brackish to freshwater species. In the Keys, not only are elevation differences between such communities very slight (Ross et al. 1994, p. 146), but the horizontal distances are small as well. Human developments will also likely be significant factors influencing whether natural communities can move and persist (IPCC 2008, p. 57; CCSP 2008, p. 7-6).

The Nature Conservancy (TNC 2010, p. 1) used high-resolution digital elevation models derived from highly accurate Light Detection and Ranging (LIDAR) remote sensing technology to predict future shorelines and distribution of habitat types for Big Pine Key based on sea level rise predictions ranging from the best-case to worst-case scenarios described in current scientific literature. In the Florida Keys, TNC models predicted that sea level rise will first result in the conversion of habitat, and eventually the complete inundation of habitat. In the best-case scenario, a rise of 7 inches (18 cm) would result in the inundation of 1,840 ac (745 ha) (34 percent) of Big Pine Key and the loss of 11 percent of the island's upland habitat (TNC 2010, p. 1). In the worst-case scenario, a rise of 4.6 feet (140 cm) would result in the inundation of about 5,950 ac (2,409 ha) (96 percent) and the loss of all upland habitat (TNC 2010, p. 1).

Similarly, using a spatially explicit model for the Keys, Ross et al. (2009, p. 473) found that mangrove habitats will expand steadily at the expense of upland and traditional habitats as sea level rises. Most of the upland and transitional habitat in the central portion of Sugarloaf Key is projected to be lost with a 0.2 m-rise (0.7 ft-rise) in sea level; a 0.5-m rise (1.6 ft-rise) in sea level can result in a 95 percent loss of upland habitat by 2100 (Ross et al. 2009, 473). Furthermore, Ross et al. (2009, p. 471-478) suggest that interactions between sea-level rise and pulse disturbances (e.g., storm surges or fire [see Factor E]) can cause vegetation to change sooner than projected based on sea level alone.

The Science and Technology Committee of the Miami-Dade County Climate Change Task Force (MDCCCTF) (2008, p. 1) recognized that significant sea level rise is a very real threat to the near future for Miami-Dade County. In a January 2008 statement, the MDCCCTF (2008, p. 2-3) warned that sea-level is expected to rise at least 3-5 feet (0.9-1.5 m) within this century. With a 3-4 foot (0.9-1.2 m) rise in sea level (above baseline) in Miami-Dade County: "Spring high tides would be at about + 6 to 7 feet; freshwater resources would be gone; the Everglades would be inundated on the west side of Miami-Dade County; the barrier islands would be largely inundated; storm surges would be devastating; landfill sites would be exposed to erosion contaminating marine and coastal environments. Freshwater and coastal mangrove wetlands will not keep up with or offset sea level rises of two feet per century or greater. With a five foot rise (spring tides at nearly +8 feet), Miami-Dade County will be extremely diminished"(MDCCCTF 2008, p. 2-3).

In summary, despite substantial habitat losses, the threat of habitat destruction or modification of remaining unprotected pine rocklands continues. Any sporadic occurrences of the butterfly and suitable habitat on unprotected pine rocklands outside of ENP and NKDR largely remain at risk to development. These threats are considered to be of high magnitude and imminent. Habitat loss, fire suppression, and lack of fire management in the past have led to the current fragmentation and degradation of remaining habitat. The threat of destruction, modification, or curtailment of habitat due to wildfire and fire management appears to have been lessened on ENP, but continues on NKDR and on surrounding private lands at high magnitude. This threat is imminent. Climate change and sea-level rise is expected to substantially diminish the species' already reduced habitat and restricted range. Overall threat level of habitat loss from sea-level rise is currently low, but expected to

become severe in the future.

B. Overutilization for commercial, recreational, scientific, or educational purposes. Rare butterflies and moths are highly prized by collectors and an international trade exists in specimens for both live and decorative markets, as well as the specialist trade that supplies hobbyists, collectors, and researchers (Morris et al. 1991, p. 332; Williams 1996, p. 30). The specialist trade differs from both the live and decorative market in that it concentrates on rare and threatened species (Morris et al. 1991, p. 333). In general, the rarer the species, the more valuable it is, and prices may exceed U.S. $2,000 for rare specimens (Morris et al. 1991, p. 333).

We do not have direct evidence of collection of Florida leafwing. Since the butterfly is imperiled, it is likely to be sought after by collectors. Salvato (pers. comm. 2006) has not seen specimens of the leafwing listed by the wholesale and specialty insect dealers who offer and sell butterflies to museums, artists, and collectors. However, Salvato (pers. comm. 2006) has been contacted by numerous individuals requesting specimens of the leafwing or in regard to locations where they may be collected in the field. Thus, there is an established desire for specimens.

The leafwing's occurrence largely on protected Federal lands may help protect it from collectors. Still, butterfly poaching occurs on Federal lands. One individual was found illegally collecting butterflies at Crocodile Lake National Wildlife Refuge in 2008 (A. Morkill, Service, pers. comm. 2008). In the past, when the leafwing was widespread on Big Pine Key and throughout southern Miami-Dade County, collecting likely exhibited little pressure on this species. At present, even limited collection from the small population in ENP or, if extant, NKDR could have deleterious effects on reproductive and genetic viability and thus could contribute to its eventual extinction. Illegal collection could occur in ENP or NKDR without being detected since these areas are not actively patrolled. Similarly, in some areas such as Navy Wells, there is no signage indicating collection is prohibited. Consequently, the potential for unauthorized or illegal collection of eggs, larvae, pupae, and, or adults exists and could go undetected, despite the protection provided on Federal or other public lands.

In summary, we have no direct, absolute evidence that collection of Florida leafwing is occurring at present. However, the established interest in specimens and information requests regarding its location on the part of collectors, researchers, and others suggests that collection may be occurring and has the potential to occur at any time. At present, we do not have an adequate basis to conclude that the species is currently threatened by overutilization for commercial, recreational, scientific, or educational purposes at this time. However, because there are only small populations remaining, we believe that collection has the potential to be a serious threat to the species at any time. We find this threat to be of low magnitude.

C. Disease or predation. Within the pine rocklands, eggs of the leafwing experience a high level of parasitism from trichogrammid wasps (Hymenoptera: Trichogrammidae). Once attacked

by the wasps, leafwing eggs turn black (Muyshondt 1975b, p. 169; Salvato and Hennessey 2003, p. 247). The frequency of these black eggs was noted to be as high as 100 percent in 1988-1989 surveys both in Long Pine Key and Big Pine Key (Hennessey and Habeck 1991, p. 46). The wasp, *Trichogramma* sp. near *pretiosum* Riley "Naranja species," was identified as the parasitoid and appears to be a key mortality factor for the leafwing (Hennessey and Habeck 1991, p. 16; Salvato and Hennessey 2003, p. 247). In January 2010, Salvato and Salvato (unpublished data) collected a parasitized egg in Long Pine Key that produced several adult Trichogramma wasps, suggesting this wasp serves as a consistent mortality factor for the leafwing in the Everglades. Hennessey and Habeck (1991, p. 46) found the larval hatch rate in the field for all survey areas during their 1988-1989 studies, including all mortality sources, ranged from 0 to 33 percent, depending on location and year.

The mite *Balaustium* sp. (Acari: Erythraeidae) has been observed preying upon leafwing eggs within the Everglades (Hennessey and Habeck 1991, p. 16). In May 2010, Salvato and Salvato (in press) observed erythraeid larval mite parasites on an adult Bartram's hairstreak (*Strymon acis bartrami*) (Lycaenidae) in Long Pine Key. Because Bartram's hairstreak also occurs in the pine rocklands, these mites may also parasitize leafwing adults (M. Salvato, pers. comm. 2010). In January, Salvato and Salvato (2010, p. 6-8) encountered a crab spider, *Misumenops bellulus* (Aranea: Thomisidae) consuming an early instar leafwing larvae in the Long Pine Key. In addition, other species of crab spiders (Aranea: Thomisidae), as well as ambush bugs (Insecta: Phymatidae) feed on leafwing larvae and possibly adults (M. Salvato, pers. comm. 2008, 2010). Matteson (1930, p. 8) recorded ants as predators on leafwing eggs in Miami.

Tachinid flies appear to be a parasitoid on the larval stages of the Florida leafwing, laying their eggs on the hostplant, which are subsequently ingested. Hennessey and Habeck (1991, p. 17) collected a moribund (i.e., in a dying state; near death) fifth-instar of the Florida leafwing at Long Pine Key. The specimen was host to four larvae of *Chetogena* sp. (Diptera: Tachinidae) that emerged from it in the laboratory; these larvae pupated and became adults. During January 2009, Salvato et al. (2009, p. 101) collected a late instar Florida leafwing in Long Pine Key that had been parasitized. The two tachinid larvae that emerged were identified as *Chetogena scutellaris* (Salvato et al. 2009, p. 101). Salvato et al. (2009, p. 101) have also observed several other moribund late-instar Florida leafwings in Long Pine Key suggesting that *Chetogena* may serve as a consistent mortality factor to the species in this part of its range. Caldas (1996, p. 89) found fifth instar larval parasitism by tachinid flies to be as high as 53 percent for *Anaea* (= *Memphis*) *ryphea* Cramer.

Salvato et al. (2008, p. 237) observed a biting-midge, *Forcipomyia* (*Microhelea*) *fuliginosa* (Diptera: Ceratopogonidae) feeding on an early instar Florida leafwing larva within the Everglades. In January 2010, Salvato and Salvato (unpublished data) observed a late instar leafwing larva with two *F*. (*M*.) *fuliginosa* midges attached. However, while parasitism from biting midges proved fatal for the early instar leafwing larva discussed in Salvato et al. (2008, p. 237), this parasitized older larva survived the encounter to successfully emerged as an adult on February 26, 2010 (M. Salvato, pers. comm. 2010). The role of this ectoparasite in the species' natural history will require further study. Salvato and Salvato (in press) have

monitored Florida leafwing larval development in the field for several years at Long Pine Key. These studies have indicated that annual Florida leafwing larval mortality from various parasites and predators ranges from 50 to 72 percent (Salvato and Salvato, unpublished data).

Hennessey and Habeck (1991, p. 17) encountered a pupa of the Florida leafwing on Big Pine Key that was in the process of being consumed by ants (species not specified). In February 2009, Land (pers. comm. 2009b) observed an ant carrying a leafwing larva in ENP. Minno (pers. comm. 2009b) identified it as the native *Pseudomyrmex pallidus*, but notes that the exotic Mexican twig ant (*Pseudomyrmex gracilis* formerly *P. mexicanus*) also consumes immature Lepidoptera. On February 6, 2010, Salvato and Salvato (unpublished data) observed a female leafwing lay six eggs in Long Pine Key. Follow-up monitoring on February 11, 2010 indicated that two of the six eggs had been removed and were most likely predated by ants (other forms of predation or parasitism normally leave some sort of trace evidence, while ants remove the entire egg).

Muyshondt (1975a, p. 35) suspected heavy predation on larvae *Anaea* (= *Memphis*) *morvus boisduvali* (no common name) from spiders after witnessing spiders in the proximity of leaves where larvae had been feeding. Spiders appear to prey upon adult Florida leafwing as indicated from a photograph in Glassberg et al. (2000, p. 99) of a lynx spider (Aranea: Oxyopidae) with a captured adult. However, Rutkowski (1971, p. 137) watched a spider (species not specified) quickly release an adult leafwing from its web after an initial taste. This suggests the Florida leafwing may be chemically protected from certain predatory species. Salvato (pers. comm. 2006) has examined the bite marks on wings of numerous adults in the field indicating a variety birds and lizards are among the predators for this species.

At this time, it is not known to what extent predation or parasitism may be a threat to the Florida leafwing. Parasitism and predation are a natural part of the life history of the species; studies have documented a wide array of predators and parasitoids and, in some cases, high levels of larval mortality. . Given the species' low numbers and few occurrences, it is unclear how the Florida leafwing will respond to these factors. Predation and parasitism may now be considered threats because of the species' current tenuous status. Disease is not known to be a threat.

D. <u>The inadequacy of existing regulatory mechanisms</u>. This species is not listed in the State of Florida. Federal, State, and local laws have not been sufficient to prevent past and ongoing impacts to Florida leafwing or its habitat.

For scientific research on and, or collection of the leafwing at ENP and, or, if extant, NKDR, a permit is required from the NPS or the Service, respectively. Although the leafwing occurs on Federal land which offers protection, these areas are vast and open to the public. Public lands can be heavily used, with signage prohibiting collection often lacking and patrolling or monitoring of activities largely absent. Therefore, illegal collection could occur without being detected. Since the leafwing is not listed by the State, it is not protected from being killed and from unauthorized take if encountered outside of NKDR or ENP. Consequently,

the potential for unauthorized or illegal collection of the leafwing (eggs, larvae, pupae, or adults) exists, as discussed under Factor B above and could go undetected, despite its occurrence on Federal lands.

The 1979 Master Plan is the plan of record for ENP, however the NPS is currently preparing a new General Management Plan for ENP (F. Herling, NPS, pers. comm. 2006). The current plan for ENP indicates one goal as "Natural and cultural resources and associated values are protected, restored and maintained in good condition and managed within their broader ecosystem and cultural context." (NPS 2000, p. 10). However, the Master Plan is not regulatory and its implementation is not mandatory.

Similarly, the Comprehensive Conservation Plan (CCP) is the principal guiding document for National Wildlife Refuges, and the Service has developed a CCP for NKDR. This plan specifically addresses strategies for the recovery of the Florida leafwing, Bartram's hairstreak, and Miami blue (*Cyclargus thomasi bethunebakeri*) (C. Anderson, pers. comm. 2010). The extent to which NKDR will have the resources necessary to meet its management needs is unknown.

At this time, the protection currently afforded the leafwing is limited; there is little protection to the species' occupied habitat, and no protection of unoccupied habitat. The current management plan at ENP does not specifically address the leafwing. Although efforts are underway to improve habitat conditions at ENP and NKDR, land management practices do not currently address all of the butterfly's specific life history needs. Therefore, we conclude that existing regulatory mechanisms are inadequate to protect the leafwing and its habitat, we find that this is a threat of moderate magnitude, but it is imminent.

E. Other natural or manmade factors affecting its continued existence. Natural or prescribed fire can be a threat to the butterfly. Whereas adults have abilities to move from fire, immature stages (eggs, larvae) are likely to be destroyed by fire (M. Minno, pers. comm. 2009a). Large-scale fires occurring in an extensive area of hostplant, fires occurring too frequently, or fires at sensitive times of the species' lifecycle may have serious consequences, given the species' tenuous status. For example, adults are scarce to absent during the summer, thus summer fires could impact or eliminate the butterfly (M. Minno, pers. comm. 2009a). Known colonies should not be burned in their entirety (M. Minno, pers. comm. 2009a).

In years where abundance is especially low, specific areas of occupied habitat may need to be avoided to help safeguard the species over the short- and long-term (S. Perry, pers. comm. 2007; Minno and Minno 2008, p. 1). Fire plans need to be reviewed well in advance of ignition with time to consider any recent changes in butterfly status (S. Perry, pers. comm. 2007). In addition to internal review, plans should be examined annually by species experts so that short-term negative effects from fire (i.e., loss of hostplants, loss of eggs and larvae) can be avoided or minimized. If future management activities are not carefully conducted, remaining populations could be depressed further (M. Salvato, pers. comm. 2008; Minno and Minno 2008, p. 1).

Salvato and Salvato (in press) documented similar adult Florida leafwing densities, both prior to and following prescribed burns in Long Pine Key, throughout their 1999-2008 studies suggesting the species can quickly recolonize pine rocklands following a fire. Surveys conducted shortly after burns often found adults actively exploring the recently burned locations in search of new hostplant growth (Salvato and Salvato 2008, p. 326; Salvato and Salvato, in press). Although Salvato and Salvato (in press) occasionally encountered signs of reproduction within recently burned Long Pine Key locations at approximately 6 weeks post-burn, the majority of their observations indicated that oviposition and larval activity increased at about 3-6 months post-burn. This suggests there may be some lag time between hostplant resurgence and compatibility with recolonization.

ENP is currently monitoring the effects of fire on croton, including leafwing larvae and adults within study plots (see Monitoring). The trends observed in study plots in ENP suggest that resprouts of burned pineland croton become suitable hostplants within 6 months post-fire (A. Land, pers. comm. 2009a). When croton is growing in areas with favorable topography and fuel loading, burning during wet summer conditions can leave a portion of the hostplants unburned (A. Land, pers. comm. 2009a; Salvato and Salvato, in press). Further research is needed to determine the number of unburned refugia needed as well as size of and distance between refugia.

As the amount of human activity and size of the human population has increased in south Florida, so has the control of salt marsh mosquitoes [*Aedes sollicitans* (Walker) and *A. taeniorhynchus* (Wiedemann)]. To suppress mosquitoes, second-generation organophosphates (naled) and pyrethroid (permethrin) adulticides are used year-round throughout south Florida and from May to November in the Keys by mosquito control districts (Hennessey et al. 1992, p. 215; Salvato 1999, p. 10). Despite improved mosquito control practices, the use of adulticides, applied using both aerial and ground-based methods to control mosquitoes, present collateral effects on non-target species.

The lethal effect of second-generation organophosphate pesticides, such as naled and fenthion (adulticides), on non-target Lepidoptera was well noted initially in south Florida and the Keys, with the decline of the endangered Schaus swallowtail butterfly (Emmel and Tucker 1991, p. 19; Eliazar 1992, p.10). This species' dramatic decline in the early 1970s coincided with the expanded use of chemical pesticides by the Monroe County Mosquito Control District (MCMCD), now known as the Florida Keys Mosquito Control District (FKMCD) on the northern Keys (Emmel and Tucker 1991, p. 19; Eliazar 1992, p. 10). When spraying was halted during two periods (1987 and 1989-1992), the species began to recover (Emmel and Tucker 1991, p. 19; Eliazar 1992, p. 10). The Schaus swallowtail's immediate decline when applications resumed suggested the adverse effect chemical pesticides have on non-target species. Studies conducted by Hennessey et al. (1992, p. 715) illustrated the presence of spray residue long after application in the habitat of the Schaus swallowtail and several other imperiled butterflies. Baggett (1982, p. 80) also suggested that the rapid decline in several populations of butterflies in the Keys was directly attributable to mosquito control pesticide applications.

Eliazar (1992, p. 1-52) conducted intensive testing on the effects of naled and fenthion on several south Florida butterfly species. His results indicated that the pesticides and their field application rates, particularly those of naled, were extremely toxic to non-target Lepidoptera and were being administered in the field at levels above the dosage required to kill target *Aedes* mosquitoes. Eliazar's naled experiments, conducted in the laboratory, included several butterfly species (not Florida leafwing) likely to be found in the lower Keys. Results from this study suggest that naled or fenthion used at the field application rates may have lethal or at least sublethal effects on Florida leafwing, as with other imperiled butterflies in south Florida. Salvato (1999, p. 1-168; 2001, p. 8-14) also measured the toxicity of naled and permethrin on a number of surrogate species and these adulticides were highly toxic towards these butterflies in both immature and adult stages. Prior to its disappearance on Big Pine Key, Salvato (1999, p. 1-168; 2001, p. 8-14; pers. comm. 2009) found the Florida leafwing to be slightly more abundant in areas where insecticide applications are restricted (i.e., Watson's Hammock, Long Pine Key) than in areas where applications occur.

Spraying practices by the FKMCD at NKDR have changed to reduce pesticide use over the years. According to the Special Use Permit issued by the Service, the number of aerially applied naled treatments allowed on NKDR has been reduced to a specified allotment (i.e., 9 per mosquito season, no closer than 5 days apart [R. Frakes, Service, pers. comm. 2008]). These changes were made after the Service reviewed the toxicity of naled on federally listed species that occur within NKDR; however, this analysis did not include species of Lepidoptera, since none on NKDR are listed. Since insects are more sensitive to organophosphates than the vertebrate species considered in the analysis, negative impacts to Lepidoptera, including the Florida leafwing, if extant, from continued naled applications will likely occur, despite the reduced use of this insecticide. The Service plans to use information from pesticide studies currently underway (see Conservation Measures) to more fully analyze effects to listed species and candidate species on Federal lands.

The small, outlying areas of NKDR have been designated no-spray zones by agreement between the Service and FKMCD. The Service is working towards expanding no-spray zones (A. Morkill, pers. comm. 2010). However, substantial areas of pine rocklands within NKDR except Watson's Hammock on Big Pine Key are sprayed with naled (aerially applied adulticide); additionally, residential areas and roadsides across Big Pine Key are treated with permethrin (ground-based applied adulticide) (Salvato 2001, p. 10). In short, substantial areas of Big Pine Key, except Watson's Hammock and Cactus Hammock, are sprayed with naled or permethrin. Therefore, the Florida leafwing (if present) and its habitat on Big Pine Key are directly exposed to adulticides used for mosquito control. While the Florida leafwing has not been observed on Big Pine Key since 2006, suitable habitat on the island remains. Expansion of no-spray zones may possibly aid the Florida leafwing, if undetected occurrences remain, if natural recolonization occurs, or if reintroduction efforts are initiated.

Designation of no-spray zones does not mean a lack of chemical intrusion. When these zones were created in 1989, pesticide drift downwind into them had not been documented. However, Hennessey et al. (1992, p. 715) detected naled residues 750 m (2,460 feet) into the no-spray zone at Watson's Hammock and 150 m (492 feet) at Cactus Hammock. Truck-

applied ultra-low-volume (ULV) fenthion, sprayed primarily in residential areas, did not appear to drift into non-target areas. This study indicated that naled remained in the habitat well into midday, posing risk to diurnally active non-targets, such as the leafwing. In a more recent study by Florida A&M University involving the candidate Miami blue butterfly in north Key Largo (Zhong et al. 2009, p. 1-37), substantial extent of drift (naled) has also been reported. Drift up to four miles from the application site were detected in one trial; however, it is not yet known if adverse impacts occur at the residue level detected at that distance from the application zone (R. Frakes, pers. comm. 2008). Overall, a total of 9 of 18 samples in the drift zone and 1 of 18 samples in the control zone had detectable concentrations of naled (Zhong et al. 2009, p. 12). Residue distribution following aerial application of naled can be affected by numerous factors, such as spray altitude, aircraft speed, nozzle size, wind speed, wind direction, landscape architecture, and microscale differences in air flow and turbulence (Zhong et al. 2009, p. 14). Therefore, if still utilizing Watson's Hammock, leafwings may be exposed to chemical residues from aerial application of pesticides despite its location within a no-spray zone.

Pierce (2009, p. 1-20) is conducting a study to determine the concentration and persistence of mosquito control adulticides within NKDR on Big Pine Key. Permethrin was found to drift considerable distances from the application area and to persist for weeks after application (Pierce 2009, p. 15). The average half-life for permethrin on foliage was 60 hours, and permethrin concentrations approached 250 ng/g leaf, indicating that permethrin would be present on leaves in concentrations near 1 ng/g leaf after 20 days (Pierce 2009, p. 15). With weekly or bi-weekly permethrin applications within the residential communities, foliage within and adjacent to residential communities retained high concentrations of permethrin throughout the mosquito pesticide application season (Pierce 2009, p. 15-16). In addition, permethrin concentrations observed at a "no spray" control site indicated considerable drift from truck applications in nearby residential communities, suggesting the need for additional monitoring to assess the extent of drift and the persistent concentrations of permethrin that are impacting remote (and residential) areas of the NKDR (Pierce 2009, p. 16). Naled also was observed to drift into non-application areas, but the persistence was much less than permethrin; half-life was about 6 hours (Pierce 2009, p. 15). Overall, the persistence of permethrin on foliage resulted in simultaneous exposure to foliage-eating non-target organisms, even when naled was applied at a later date. These results raise the concern for synergistic effects from simultaneous exposure to permethrin, naled, and dichlorvos (breakdown product of the adulticide, Dibrom) (Pierce 2009, p. 16). These findings suggest that truck-based applications of adulticides through aerial and truck applications, may pose a threat to Florida leafwing, if still present on Big Pine Key.

In general Long Pine Key does not appear to be regularly impacted by mosquito control practices, except for the use of adulticides (e.g., Sumithrin [Anvil]) in residential areas and campgrounds. Housing areas, maintenance areas, outside work areas for park maintenance staff and contractors, and areas near buildings have been sprayed in the past (S. Perry, pers. comm. 2007). In addition, there have been reports that operators frequently leave the foggers on when traveling from one area to another within ENP (S. Perry, pers. comm. 2007). Spraying has occurred following hurricanes (S. Perry, pers. comm. 2008). In 2008, however,

no spraying was conducted in or near Long Pine Key (S. Perry, pers. comm. 2008). Perry (pers. comm. 2008) believes it is important that spraying does not occur in or near the pinelands or in coastal areas of ENP. Sporadic leafwing populations, if present, adjacent to and outside ENP in suitable and potential habitat within Miami-Dade County are also vulnerable to the lethal and sublethal effects of adulticide applications.

Butterflies in south Florida and the Keys, such as the Florida leafwing, have adapted over time to the influence of tropical storms and other forms of adverse weather conditions (Salvato and Salvato 2007, p. 154). However, given the substantial reduction in the Florida leafwing's historic range in the past 50 years, the threat and impact of tropical storms and hurricanes on the remaining populations of this species is much greater than when its distribution was more widespread.

According to the National Oceanographic and Atmospheric Administration, Miami-Dade County, the Keys, and western Cuba are the most storm-prone areas in the Caribbean so this threat is expected to continue. Salvato and Salvato (in press) indicated that Florida leafwing recovery from tropical storm influence within the Everglades pine rocklands varied greatly based on the amount of hostplant available post-storm and storm severity. In October 2005, Watson's Hammock in NKDR was heavily damaged from Hurricane Wilma. Native vegetation across much of Watson's Hammock, including croton, was slow to recover. The Florida leafwing has not been observed in Watson's Hammock since the storm. Although numbers of the Florida leafwing had substantially declined prior to storm activity across the island, hostplant decline has likely prevented any potential resurgence for the species recovery in areas such as Watson's Hammock.

In addition, unusually cold temperatures were encountered throughout southern Florida during winter of 2010. Frost in January, 2010 resulted in substantial die back of native plants and resulted in damage and widespread defoliation of pineland croton in Long Pine Key (J. Sadle, pers. comm. 2010a; A. Land, pers. comm. 2010; Hallac et al. 2010, p. 2-3). Larval leafwings were impacted by the cold as approximately 50 percent of the individuals were observed to be dead or without nearby food supplies at three locations within Long Pine Key (Hallac et al. 2010, p. 3). Although Salvato and Salvato (unpublished data) did not record increased mortality on their survey sites, they did encounter larvae on frost-killed plants. Larvae unable to successfully reach healthier adjacent hostplants likely perished. Sadle (pers. comm. 2009) also noted frost damage on croton in Long Pine Key in 2009, but observed living larvae on February 5, 2009 when temperatures were at or barely above freezing (36 F in Homestead and frost on the ground in Long Pine Key). It is not clear what the short or long-term impacts of prolonged cold periods may be on Florida leafwing populations; it is likely that prolonged cold periods have some negative impacts on both the species and its hostplant (J. Sadle, pers. comm. 2010a, A. Land, pers. comm. 2010).

The Florida leafwing is vulnerable to extinction due to populations that are small and isolated. A population of 1,000 has been suggested as marginally viable for an insect, although this is likely highly dependent upon type of species (D. Schweitzer, The Nature Conservancy, pers. comm. 2003). Schweitzer (pers. comm. 2003) has also suggested that

butterfly populations of less than 200 adults per generation would have difficulty surviving over the long-term.

In general, isolation, whether caused by geographic distance, ecological factors, or reproductive strategy, will likely prevent the influx of new genetic material and can result in a highly inbred population with low viability and, or fecundity (Chesser 1983, p. 68). Natural fluctuations in rainfall, hostplant vigor, or predation may weaken a population to such an extent that recovery to a viable level would be impossible. Isolation of habitat can prevent recolonization from other sites and result in extinction. The Florida leafwing is restricted to a single or possibly few locations. Distance between populations and the small size of highly sporadic populations make recolonization unlikely if extirpated. The extent of habitat fragmentation leads us to believe this species is vulnerable due to the small number of populations, their small size, and their relative isolation.

In summary, the Florida leafwing is vulnerable to a wide array of natural and human factors. Fire can cause mortality of immature stages. Large-scale fires (multiple burn units or without refugia), fires occurring too frequently (e.g., < 3 years or before recovery), or fires at sensitive times may have severe impacts on the species, given its current status. We find this threat to be severe and imminent. Application of mosquito control pesticides are a threat of moderate magnitude to the butterfly, if it still occurs outside of ENP. Hurricanes, prolonged cold events, small population size, and few occurrences in a restricted range are also serious threats, given the species' overall vulnerability; overall we find these to be high in magnitude and imminent.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

Fire management practices on pine rocklands within ENP, Miami-Dade County, and potentially NKDR may provide benefits for the Florida leafwing. The NPS is in the process of mapping pineland croton within ENP (J. Sadle, pers. comm. 2010b) and has established croton monitoring plots (see Monitoring below). The NKDR is mapping areas of croton and expanding its efforts to use prescribed fire. Two burns totaling 4 ha (10 acres) were burned on NKDR in 2009 (A. Morkill, pers. comm. 2010). In addition, Miami-Dade County is working with Fairchild Tropical Botanic Garden (FTBG) to implement a fire monitoring program at its preserves (Possley and Maschinski 2007, 1-13; J. Maguire, pers. comm. 2008b). As part of this program, croton will be mapped and fire effects will be studied (J. Maguire, pers. comm. 2008a; Possley and Maschinski 2007, p. 3).

The Service has funded a comprehensive laboratory study with Florida International University to refine knowledge of the toxicology and effects of naled and permethrin. Specific objectives of this study are to: (1) determine the toxicity of naled and permethrin to different stages of the life cycle of butterflies at environmentally relevant concentrations of insecticides and (2) conduct a probabilistic ecological risk assessment for butterflies by comparing species sensitivity distributions for naled, dichlorvos, and permethrin with exposure distributions for each insecticide at different sites. The Service has also provided funding to Mote Marine Laboratory to better estimate toxicological effects in the field. Specific objectives of this study are to: (1) determine mosquito adulticide distribution, concentrations, and persistence in the field following

routine mosquito control operations and (2) provide empirical data from field studies for comparison with laboratory toxicity studies of mosquito adulticide effects on lepidopteran species. In addition, a Service representative participates in the field study currently underway in with Florida A&M University, which is testing the effects of adulticides on the Miami blue butterfly, including the amount of deposition and extent of drift. The Service will have a better understanding of the risk to its trust resources by some mosquito control practices following completion of these studies. In addition, the Service is working with the FKMCD in an effort to expand no-spray zones in the Keys. The Service is seeking additional funding to determine the extent of permethrin drift and accumulation within NKDR (A. Morkill, pers. comm. 2009). The NPS is minimizing its use of pesticides in the pinelands and coastal areas of ENP.

The State's Florida Comprehensive Wildlife Conservation Strategy discusses management of pine rocklands, but has not been implemented or funded (FWC 2005, p. 283-286).

SUMMARY OF THREATS

The Florida leafwing occurs in ENP and only sporadically in locations such as Navy Wells and other pine rockland fragments in Miami-Dade County. The butterfly has , not been observed on Big Pine Key since 2006 and may now be extirpated from the Keys. Habitat of the leafwing, pine rocklands, is globally imperiled and dependent upon fire. Inappropriate fire management or wildfire could destroy immature stages and impact the availability of pineland croton, its sole host plant. Fire suppression or inability to conduct prescribed fire may also result in loss of habitat. Climatic changes and sea level rise are long-term threats that will continue; these factors are expected to impact pine rocklands and ultimately reduce the extent of available habitat. In addition, the Florida leafwing and its habitat are vulnerable to a wide variety of natural and human factors. Small, isolated population(s) are exposed to extreme weather events (e.g., hurricanes, prolonged cold temperatures). Mosquito control practices are a threat to occurrences if any still occur outside of ENP. Further reduction of the population(s), especially due to catastrophic weather, pesticide application, loss of suitable habitat, inappropriate fire management, or lack of prescribed fire could severely reduce the likelihood of this butterfly's survival. Natural predation and parasitism may now also be threats given the leafwing's low population size and few occurrences. Finally, the established interest in leafwing specimens and information requests regarding its location on the part of collectors, researchers, and others suggests that collection may be occurring and has the potential to occur at any time. At the present time, there is insufficient information to conclude that the species is currently threatened by overutilization for commercial, recreational, scientific, or educational purposes. We find that this species is warranted for listing throughout all of its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

RECOMMENDED CONSERVATION MEASURES

- Continued and additional surveys are needed in Miami-Dade County, ENP, and the Keys.
- Review and adjust fire management practices as needed to help maintain or expand the population sizes or numbers of populations. Continue to seek input on proposed burn plans on an annual basis from species experts. Coordinate activities among fire crews, biologists, and lepidopterists and use adaptive management as needed.

- Protect remnant patches of pine rocklands and use prescribed fire to restore native plant diversity.
- Determine the distribution and abundance of pineland croton within ENP.
- Restore pineland croton to relict fragments of pine rocklands within the leafwing's historic range to expand its occupied habitat.
- Establish buffer zones with croton as refugia during prescribed fire. Conduct research to assess the efficacy of buffer zones (C. Anderson, pers. comm. 2010; J. Sadle, pers. comm. 2010a).
- Address concerns regarding impacts of mosquito control activities in relation to pine rockland habitats on NKDR and adjacent properties. Establish additional no-spray zones and wider buffer areas around these zones.
- Continue to participate and contribute to the Imperiled Butterfly Working Group, which is aimed at conserving south Florida's imperiled butterflies.
- Evaluate the need for establishment of *ex situ* conservation populations in the laboratory (J. Sadle, pers. comm. 2010a). If pursued, ensure that this action is consistent with the Service's captive propagation and reintroduction policy and that adequate funding and support would be available. Previous captive propagation and reintroduction efforts for other imperiled butterflies in Florida have been largely unsuccessful.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	**Imminent**	Monotypic genus	1
		Species	2
		Subspecies/population	**3***
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude: The Florida leafwing can no longer be found on Big Pine Key and may be extirpated from the Keys. This butterfly is threatened by the combined influences of habitat destruction and modification from continued loss of unprotected pine rocklands and wildfire or fire management on protected sites. Climatic changes and sea level rise are serious long-term

threats that will reduce the extent of habitat. Mosquito control activities are a threat to the Florida leafwing if the butterfly occurs outside of ENP. Loss of genetic diversity may be a problem for the butterfly considering its small, fragmented, and isolated population(s). The probability for catastrophic events (e.g., hurricanes, prolonged cold events) and the possibility of accidental harm or habitat destruction are threats due to the small population size and limited numbers at the remaining location(s). In addition to these threats, inadequate regulatory protection continues to pose threats to the species throughout its historic range. We also recognize that illegal collection is a potential threat to the species. Natural predation and parasitism may now also be threats given the leafwing's low population size and few occurrences. Overall, we find that these threats are of high magnitude.

Imminence: The Florida leafwing can no longer be found on Big Pine Key and may now only occur in ENP. The threats of habitat destruction and modification are occurring with the continued loss of unprotected pine rocklands and wildfire or fire management on protected sites. Sea level rise is currently occurring and has resulted in the loss of pine rocklands. However, this is considered a long-term threat since we do not have evidence that it is currently affecting the remaining population(s). Mosquito control adulticides may be a threat if the butterfly still occurs outside of ENP. The threat from loss of genetic diversity within small, fragmented, and isolated population(s) is expected to continue. The likelihood of extreme weather or catastrophic events (e.g., hurricanes, prolonged cold periods) to the remaining population(s) seriously threatens the survival of this butterfly, and these threats are expected to continue. We find these threats to be currently occurring and imminent. In addition, since there is an established interest in locations and desire for specimens by collectors, researchers, and others, we believe this species may be at risk; collection may be occurring and has the potential to occur unnoticed at any time, since areas are remote and open to the public. Overall, we find the immediacy of threats to be imminent.

Rationale for Change in Listing Priority Number (insert if appropriate)

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No, however, status needs to be carefully monitored. The status and distribution of the species needs to be monitored closely to detect change and any further decline. The loss or decline of any occurrence(s) would be detrimental to the status of the species. The Service and its partners need to continue to implement actions to conserve this species, remove threats, and increase viability to the maximum extent possible.

DESCRIPTION OF MONITORING:
Surveys for the Florida leafwing butterfly are ongoing. Monitoring by Salvato began in 1997 and has been conducted either monthly or bi-monthly at various locations within the butterfly's historic range (Salvato 1999, p. 1-168; 2001, p. 8-14, pers. comm. 2009; Salvato and Hennessey 2003, p. 243-249). Surveys by other lepidopterists, agency personnel, and members of the North American Butterfly Association (NABA) occur on a periodic basis.

ENP Fire Management initiated fire effects monitoring of pineland croton in 2005. This

monitoring effort was started to provide preliminary information on pineland croton and butterfly response to fire for ENP's adaptive management program (A. Land, pers. comm. 2007, 2009a). Two study plots have been established. Biologists visit each plot monthly to measure pineland croton height and crown area, count the number of flowers and fruits, and to note the presence of eggs, larvae, and herbivory on pineland croton (A. Land, pers. comm. 2007, 2009a). The presence of adult Florida leafwing are also recorded if observed within the plot. Monitoring is continuing.

NKDR is monitoring all host plants before and after fire to check for butterfly larvae (Bartram's hairstreak) to better understand plant/butterfly response (C. Anderson, pers. comm. 2010).

Miami-Dade County is working with FTBG to implement a fire monitoring program at its preserves (J. Maguire, pers. comm. 2008b; Possley and Maschinski 2007, 1-13). The effects of fire on croton will be examined (J. Maguire, pers. comm. 2008a; Possley and Maschinski 2007, p. 3).

COORDINATION WITH STATES

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment: The Service requested new information (observations, data, reports) regarding the status of this species and any new information regarding threats to this species from: Florida Department of Agriculture and Consumer Services, Florida Department of Environmental Protection, FWC, U.S. Geological Survey, U.S. Environmental Protection Agency, National Park Service, Service (Ecological Services and National Wildlife Refuges), FNAI, Archbold Biological Station, IRC, UF, Florida International University, Randolph-Macon College, mosquito control districts, NABA, and other entities. In total, the previous assessment was sent to approximately 116 individuals.

The leafwing is recognized in Florida's Comprehensive Wildlife Conservation Strategy as one of Florida's species of greatest conservation need (FWC 2005, p. 91).

Indicate which State(s) did not provide any information or comments: Florida

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APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: _____ June 15, 2010
for Regional Director, Fish and Wildlife Service Date

Concur: _____ _____
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Director's Remarks:

Date of annual review: May 18, 2010
Conducted by: Paula Halupa, South Florida Ecological Services Office